

February 5, 2008

TO: D. Morris
FROM: S. Chhan
SUBJECT: Voyager 1 and Voyager 2 Extended Mission Supportability Study

The Resource Allocation Planning Service has completed a special study to illustrate the supportability for the Voyager 1 and Voyager 2 Mission extension requirements to the current mission requirements. The period of forecast runs from 2010 through 2013 to cover Voyager 1 and Voyager 2 requirements extension.

Summary of Results

A review of supports planned from 2010 through 2013 revealed a positive supportable level above 90% for both VGR1 and VGR2 in years 2012 and 2013. In 2010, There is one week (38) where supportable percentage is 74 % and seven weeks where supportability ranges from 77% - 79% for Voyager 1, and the rest of the weeks in 2010 are well above 80% supportable mark. There are 23 weeks in 2010 for Voyager 2 with supportability percentage below 80% and the focus will be on those weeks where supportability percentage are below 75% because from 76% or higher, the possibility of both missions to achieve their desire supportability will be achievable in the conflict negotiation process.

In year 2011 for Voyager 1, there are 15 weeks with supportable percentage between 65% - 79%. Out of the 15 weeks, only 9 weeks have the range between 65% - 75%, the rest are from 76%- 79%. The 9 weeks will be examined further in 2011 for Voyager 1. For Voyager 2 in the same year, there are 18 weeks with supportability that are below 80%, and out of the 18 weeks only 10 weeks have the range between 67% - 75%, the rest ranges from 76% - 79%.

In year 2012 and 2013, both Voyager 1 and Voyager 2 have positive supportability percentage averaging above 90% range during the time the data was generated hence the report will not focus on these two years.

Background

The Voyager 1 and Voyager 2 mission has requested that the RAPS team perform a study analyzing the impact to supportability with their extended requirements from 2010 out to 2013. These two missions will require continuation of their current support on the 70M and 34M subnets.

Voyager 1 basic requirements are 7 (8 Hour) tracking passes with one (2.5 Hour) routine uplink pass per week. The minimum of one (2.5 Hour) on the 70M for uplink per week, and the daily (8 Hour) pass on either the 34M or 70M are required. Overall, Voyager 1 have average

Figure 1: Voyager 1 ULP for 2010

[illegible][illegible]

Figure 3: VGR2 ULP for 2010

[illegible][illegible]

This study focuses on the years of the extended requirements from 2010 through 2013 on both the Voyager 1 and Voyager 2 mission on both subnets (70M and 34M), and a detail explanation of the weeks with low supportability will be examined.

Assumption

These are downtimes scheduled for 2010 - 2013 that may create contentions to VGR1 and VGR2 with other Missions and Projects re-allocating the requirements based on these downtimes:

- DSS-14 approved downtime Life Extension and Depot Level Maintenance (NIB to Life Extension) from weeks 01 – 12 in 2010
- DSS-25 approved downtime Ka U/L from weeks 13 – 16 in 2010
- DSS-46 approved downtime (Extended Downtime) entire year 2010 - Indefinite
- DSS-66 approved downtime (Extended Downtime) entire year 2010 – Indefinite

Analysis

Analysis was accomplished using the JPL Tracking Integrated Ground Resource Allocation System (TIGRAS) scheduling tool, the updated mission set database from the February 2008 Deep Space Network Interplanetary Network Customer Forum, Resource Allocation Review (DSN INCF, RAR).

The DSN can support the Voyager 1 and Voyager 2 continued requirements through 2013, there is a very high supportable percentage throughout the duration mentioned. There is however a few weeks that may have supportability below 80% in years 2010 and 2011 and these weeks will be addressed below.

In year 2010, Voyager 1 supportability percentage are positive with most weeks averaging above 80% throughout the entire year, and seven weeks that has supportability range between 77% - 79%, and only in week 38 where supportability is at 74%. In weeks 16, 24, 25, 26, 27, 40, and 43 supportability range between 77% - 79%, VGR1 should be able to negotiate their requirements well above 80% by reallocating resources of the 70M and 34M subnets at GDSCC and MDSCC and through the resource negotiation process. For weeks with the supportability range of 75% or above, VGR1 should be able to achieve their requirements and the supportability should be able to improve during the conflict negotiation process, so the focus will be towards weeks that are below the 75%. The 74% supportability in week 38 are due partly to viewperiod overlaps with all other Mission / Projects that also require the 70M and 34M subnets, and this causes contention with Voyager 1.

Figure 5: Voyager 1 and Voyager 2 Supportability for 2010

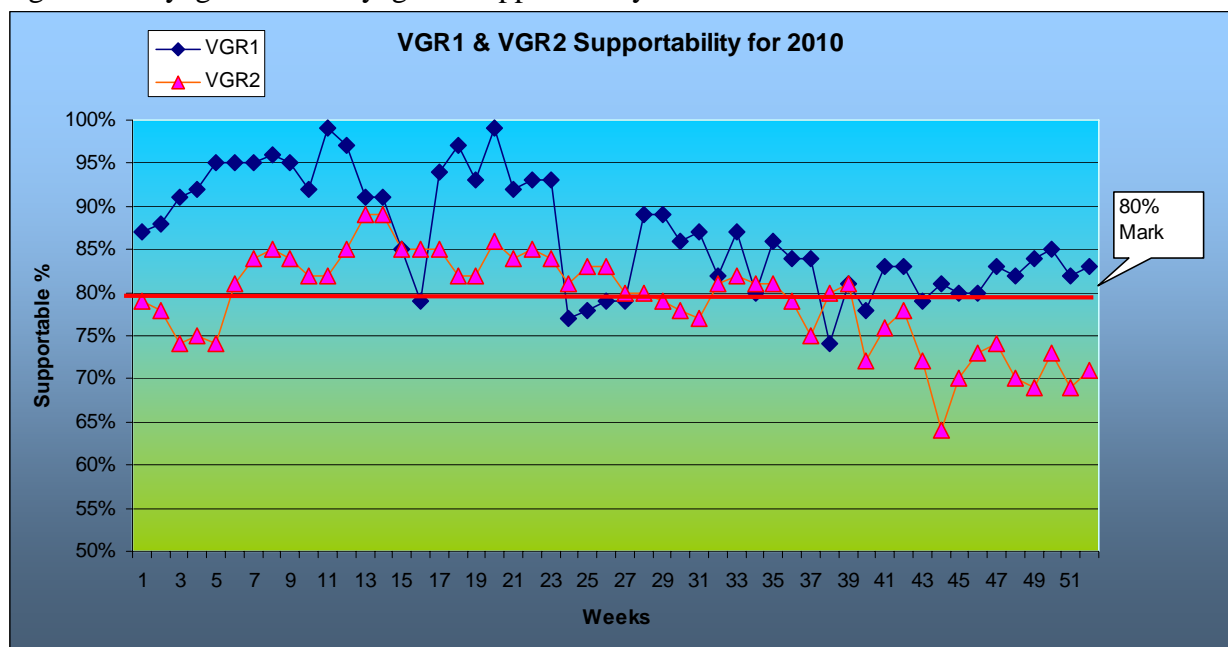
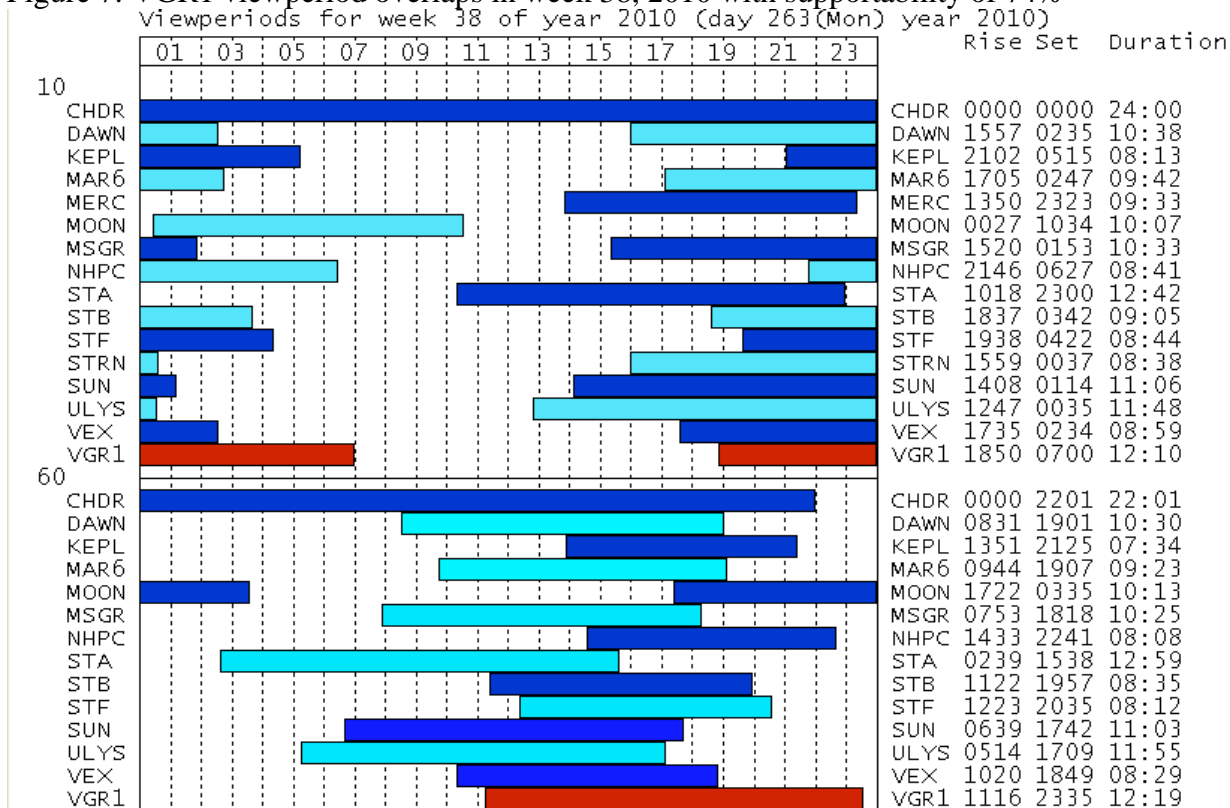


Figure 6: Supportable percentage for weeks 24-27 and week 38 with 74%

2010	Weeks	24	25	26	27	38
Voyager 1	All Subnet	77%	78%	79%	79%	74%

Figure 7: VGR1 viewperiod overlaps in week 38, 2010 with supportability of 74%



Similarly for Voyager 2 there are two periods in which supportability ranges from 74% - 79% in weeks 1 – 5 and ranges from 64% - 78% from weeks 40 – 52. A snapshot of the viewperiod of week 3 since it is in between weeks 1 – 5, which will show similar overlaps for comparison. The following are viewperiod overlaps at SPC-40 with Voyager 2 with the following missions:

Figure 8: Supportable percentage for weeks 1 - 5 and weeks 40 - 52

2010	Weeks	1	2	3	4	5	40	41	42	43	44	45	46	47	48	49	50	51	52
Voyager 2	All Subnet	79%	78%	74%	75%	74%	72%	76%	78%	72%	64%	70%	73%	74%	70%	69%	73%	69%	71%

Figure 9: VGR2 viewperiod overlaps snapshot in week 3 of 2010 with Supportability at 74%

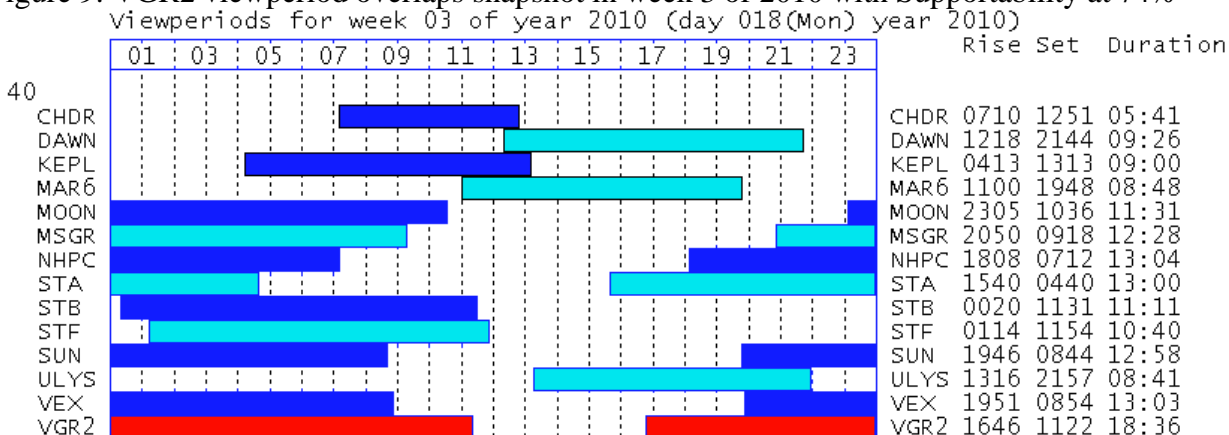
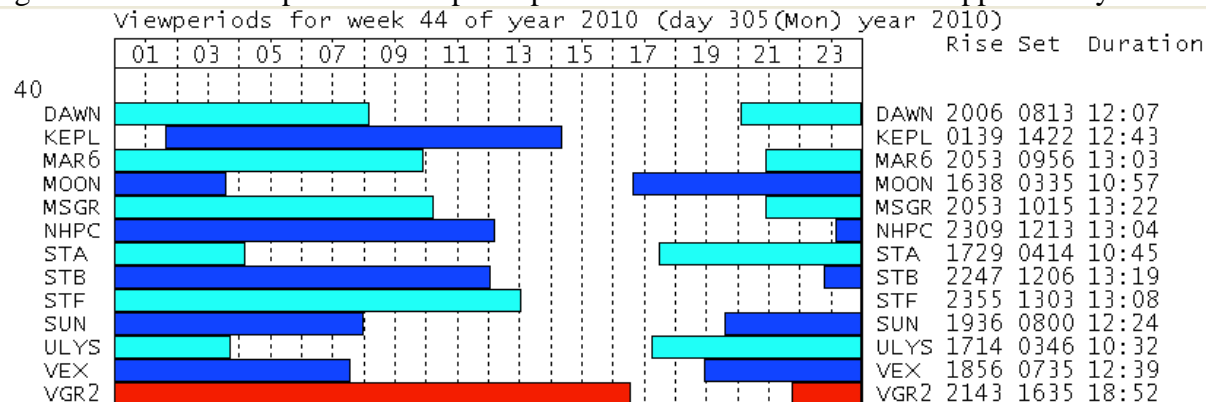


Figure 10: VGR2 viewperiod overlaps snapshot in week 44 of 2010 with Supportability at 64%



In year 2011, Voyager 1 supportability from weeks 39 – 52 will range between 65% - 76%, and the rest of the weeks result in supportability above 80% for the entire year. For Voyager 2 supportability in weeks 1 - 13 ranges from 67% - 76% with the rest of the weeks have supportability well above 80% range average.

Figure 11: Voyager 1 and Voyager 2 Supportability for 2011

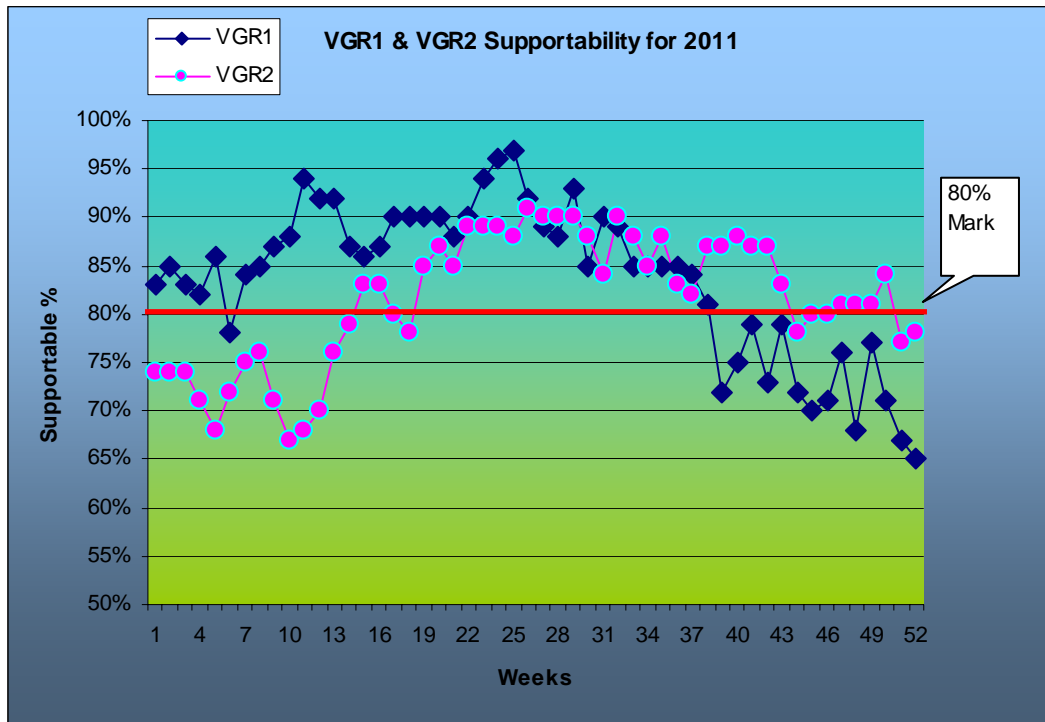


Figure 12: Supportable percentage for weeks 39 - 52

2011	Weeks	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Voyager 1	All Subnet	72%	75%	79%	73%	79%	72%	70%	71%	76%	68%	77%	71%	67%	65%

Figure 13: VGR1 viewperiod contentions in week 45 with supportability of 70% in 2011

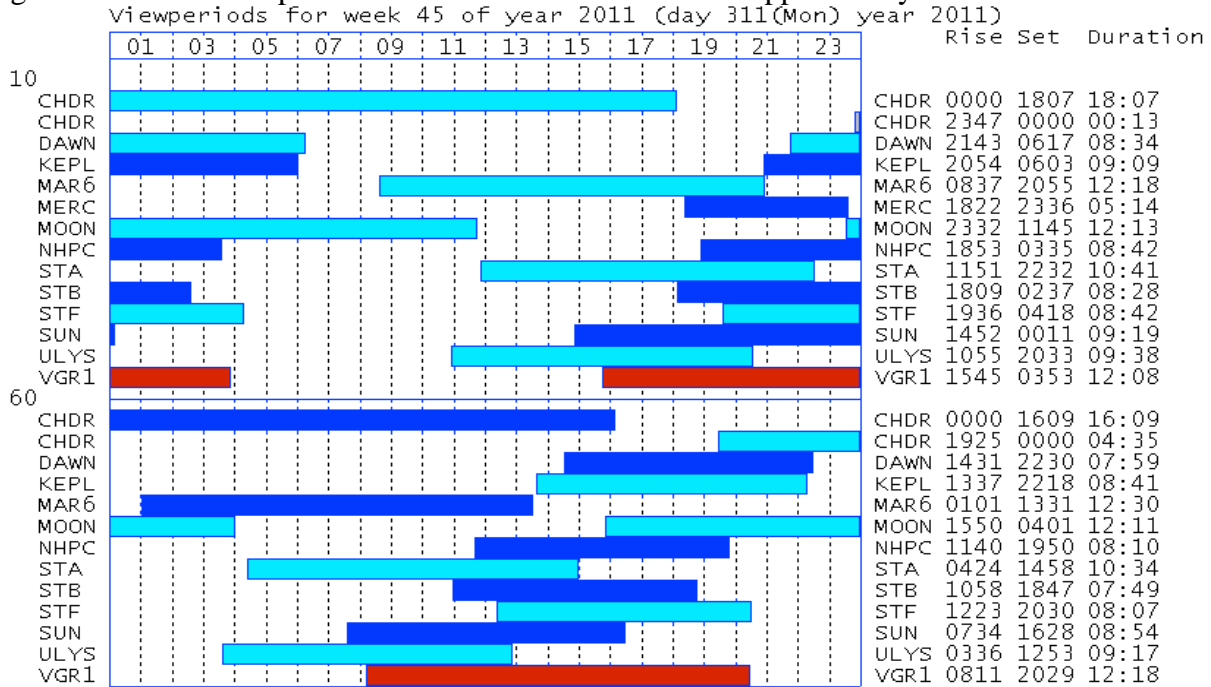


Figure 14: VGR1 viewperiod overlaps in week 52 of 2011 and supportability percentage of 65%

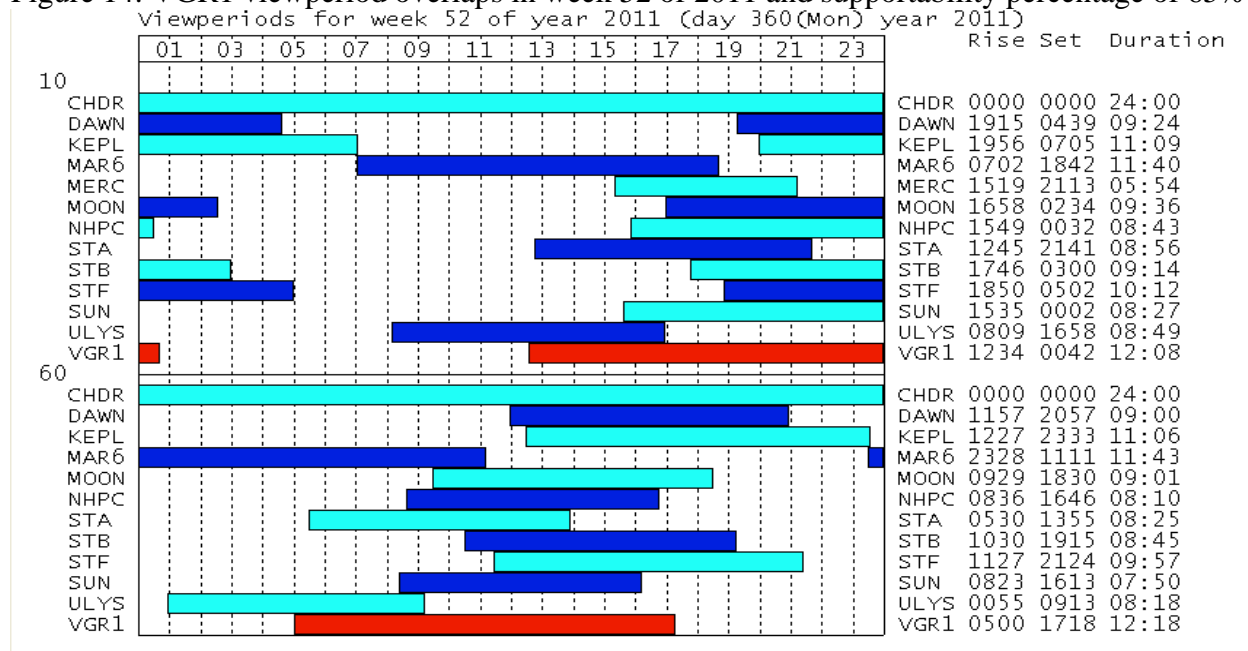


Figure 15: Supportable percentage for weeks 39 - 52

2011	Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Voyager 2	All Subnet	74%	74%	74%	71%	68%	72%	75%	76%	71%	67%	68%	70%	76%	79%

Figure 16: VGR2 viewperiod overlap snapshot of week 3 in 2011 with supportability of 74%

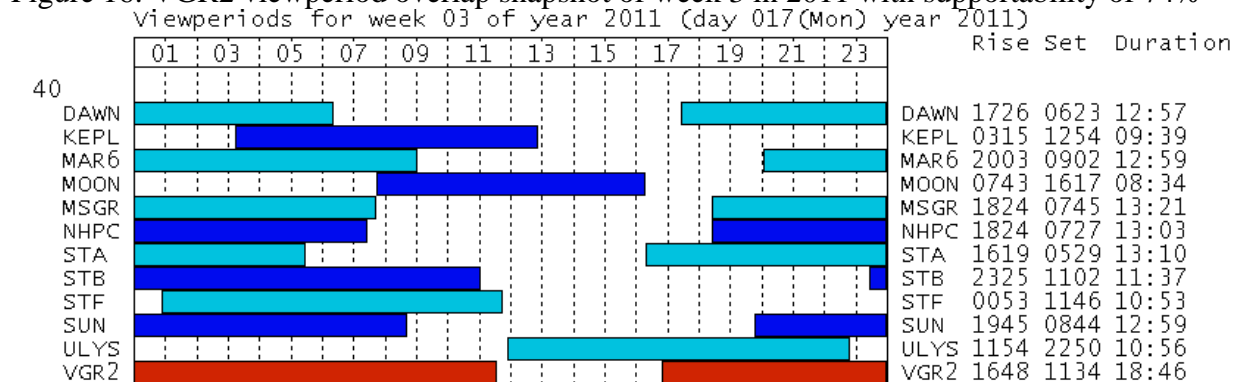
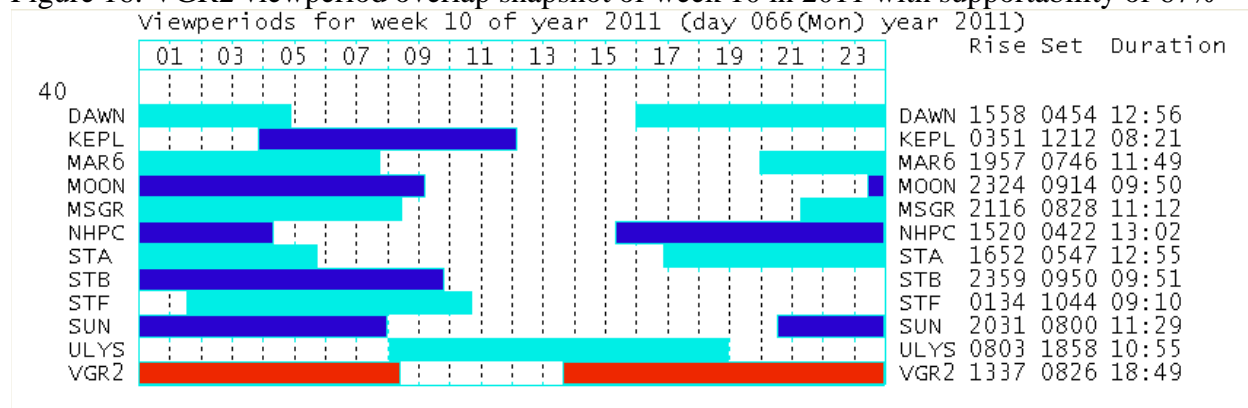
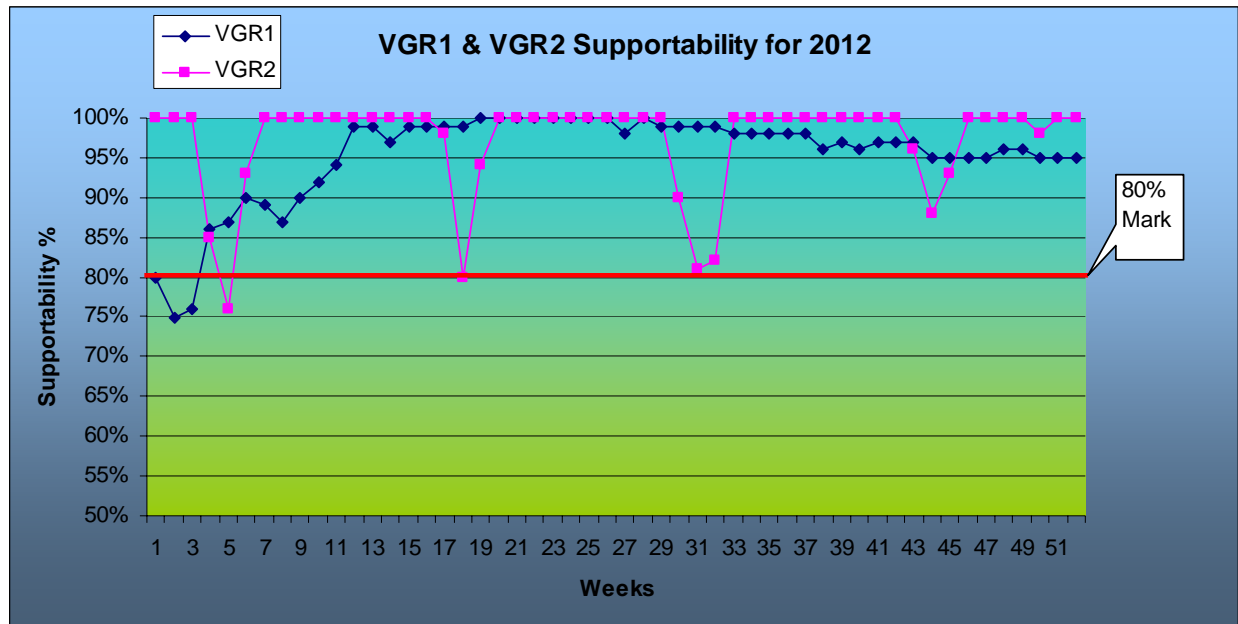


Figure 16: VGR2 viewperiod overlap snapshot of week 10 in 2011 with supportability of 67%



In year 2012, Voyager 1 supportability are above 80% except in weeks 2 (75%) and 3 (76%), and for Voyager 2 supportability are above 80% except in week 5 (76%).

Figure 17: Voyager 1 and Voyager 2 Supportability for 2012



In year 2013, Voyager 1 and Voyager 2 supportability are all above 95% throughout the year according to data forecasted on that date.

Conclusion

Forecast results for the Voyager 1 and Voyager 2 on both subnets (70-meter and 34M) combined indicate that the DSN can support the extended requirements through 2013, but slightly reducing supportability for other DSN Users as contentions for DSN resources increases.

Voyager 1 and Voyager 2 extended requirements especially with critical events should be scheduled on weeks with higher supportability and will most likely be able to resolve those contentions in weeks with low supportability.

The results of this study are subject to change, in that network loading changes, as requirements for planned missions are input and updated and periods of antenna downtime are identified.